Government of Canada
Canadian Forestry Service

Gouvernement du Canada
Service canadien des forêts

Program Review

Pacific Forestry Centre
1985 - 86

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Program Review

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1985-86

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1986

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The Canadian Forestry Service
Government of Canada

The Canadian Forestry Service is the principal source of federal expertise in forestry. Its general objective is to promote the wise management and use of Canada's forest resources for the economic, social and environmental benefit of Canadians.

The following are the main functions of the CFS:

1. Coordination of federal policies, for the promotion of better resource management and forest industry development.

2. Provision of scientific and technological leadership in forestry through research and development.

3. Provision and analysis of national and international statistics and information as a basis for policy formulation.

4. Development and certification of codes and standards for wood product performance.

5. Protection of Canada's forests from foreign pests.

6. Fostering the potential use of the forest resource for energy.

7. Contributing to the environmental objectives of the government of Canada.

A number of federal agencies are involved in forestry programs and a Federal Forestry Sector Strategy Committee has been established to coordinate federal forestry activities. The Canadian Forestry Service has been designated the lead agency.

The Canadian Forestry Service is comprised of a headquarters unit, six forestry centres, and two national institutes. The forestry centres are responsive to regional priorities and maintain close liaison with the respective provincial government forestry departments and other clients. They also participate in, and frequently lead, national programs. The national institutes provide the focus for programs of national scope.

Service Canadien des Forêts
Gouvernement du Canada

Le Service canadien des forêt (SCF) réunit la majorité des spécialistes fédéraux en foresterie. Son objectif général est de promouvoir l'aménagement et l'utilisation judicieux des resources forestières du Canada pour le plus grand bien économique, social et environnemental des Canadiens.

Voici les principales fonctions du SCF:

1. Coordonner les politiques fédérales afin de favoriser l'amélioration de la gestion des ressources et l'expansion de l'industrie forestière.

2. Fournir une orientation scientifique et technologique dans le domaine de la foresterie, par la recherche et le développement.

3. Fournir et analyser les statistiques et l'information nationales et internationales qui serviront à établir les politiques.

4. Mettre au point et homologuer des codes et des normes en matière de rendement des produits du bois.

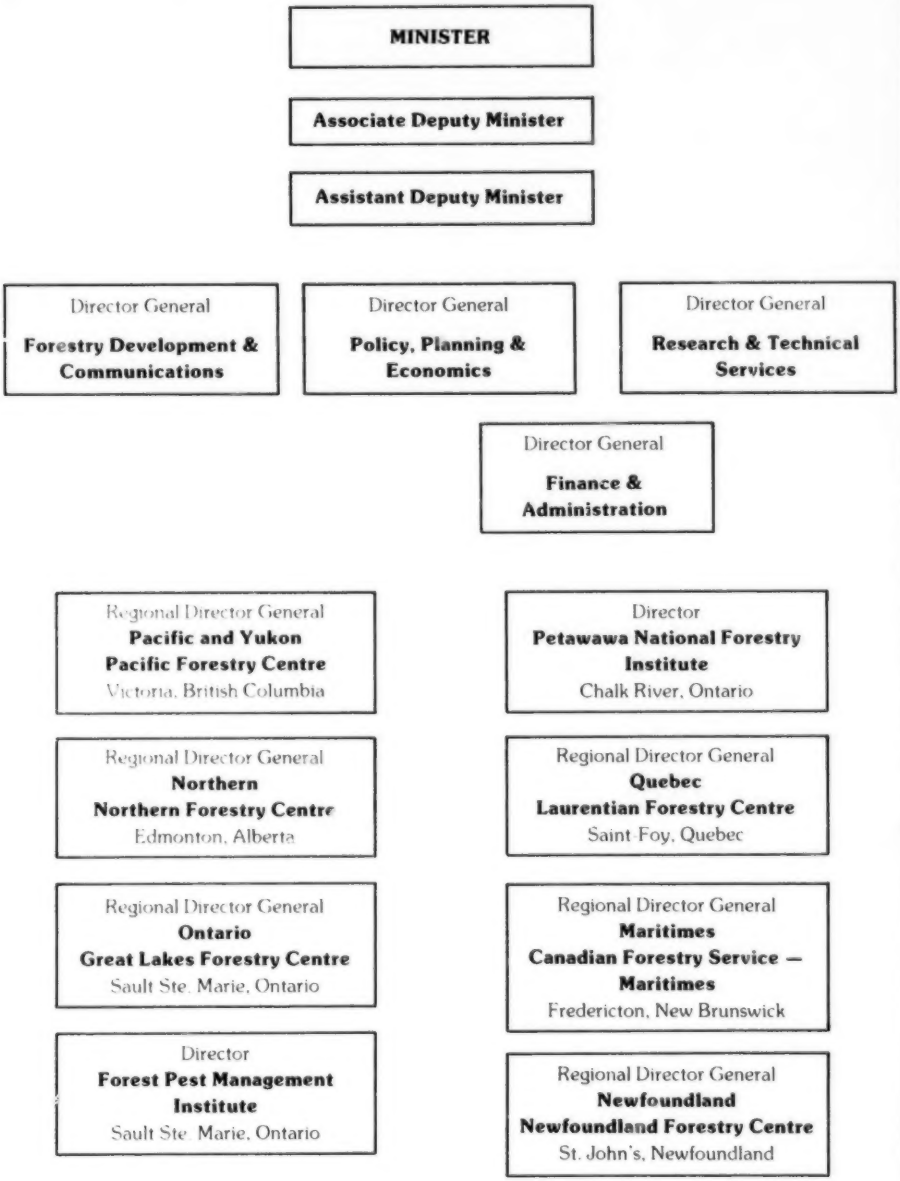
5. Protéger les forêts canadiennes en luttant contre les ravageurs étrangers.

6. Parrainer l'utilisation éventuelle des ressources forestières pour la production d'énergie.

7. Adhérer aux objectifs environnementaux du gouvernement fédéral.

Divers organismes fédéraux participent aux programmes forestiers, et un comité de la stratégie forestière fédérale a été créé pour coordonner les activités fédérales en matière de foresterie. Le SCF a été désigné organisme directeur.

Le Service canadien des forêts comprend une administration centrale, six centres de foresterie et deux instituts nationaux. Les centres de foresterie doivent répondre aux impératifs régionaux et entretenir une liaison étroite avec les ministères provinciaux des Forêts. Ils participent également à des programmes nationaux dont ils assument fréquemment la direction. Les instituts nationaux sont les foyers des programmes d'envergure nationale.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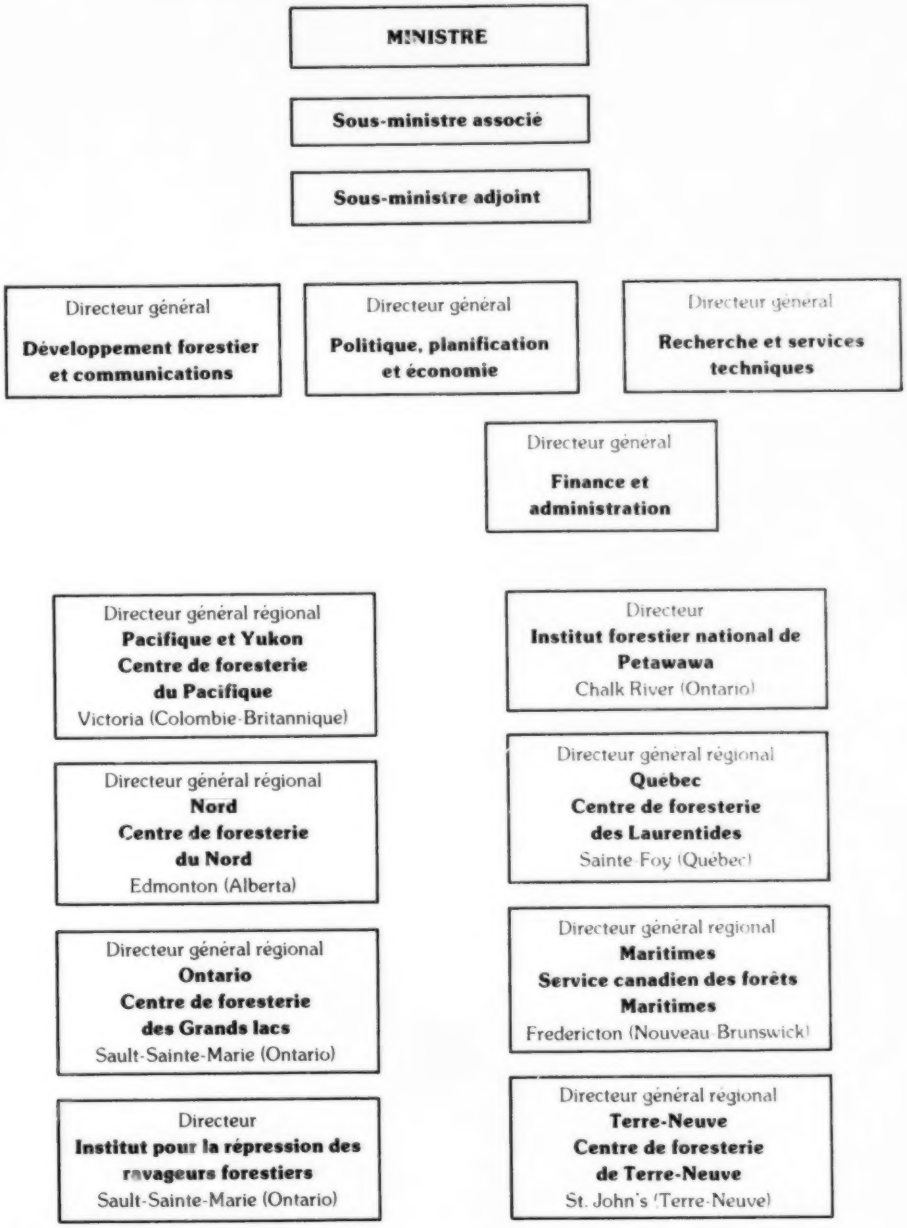
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Centre de foresterie de Terre-Neuve
St. John's (Terre-Neuve)

D. Ross Macdonald

Pacific Forestry Centre

A word from the Director-General

During the year under review the senior management of the Canadian Forestry Service, in recognition of the expanding role and mandate of the organization, made a decision to change the name of the regional establishments. Our new title, Pacific Forestry Centre, reflects the diversified program that is now underway at this Centre. Research remains our major function but our roles in managing and delivering the federal/provincial forestry agreement, job creation programs, international trade issues, market development etc. are reflected in the more general title.

In May a five-year $300 million Canada/British Columbia Forest Resource Development Agreement (FRDA) was signed by the **Honourable Gerald S. Merrithew**, Minister of State (Forestry) and the **Honourable Tom Waterland**, B.C. Minister of Forests. The two principal thrusts of the Agreement are reforestation of backlog not-satisfactorily restocked (NSR) Crown provincial lands as well as intensive silviculture of juvenile stands. It is estimated these programs will add approximately 600 000 cubic metres annually to the future sustainable yield and provide both short and long term employment opportunities for many thousand people.

September was a landmark month for this organization. The Canadian Forestry Service, with the B.C. Ministry of Forests, cohosted the 12th Commonwealth Forestry Conference in Victoria. Deputy Director **Cliff Brown** was the Secretary-General of the Conference and was supported by staff of both organizations. More than 200 delegates from 30 of the 49 Commonwealth countries participated. Much media and public attention was focussed on the Conference due to the high calibre of speakers participating.

The official opening of the expansion to the Pacific Forestry Centre was celebrated during the Conference to allow participants and guests to view the facilities. The Honourable Gerald S. Merrithew was on hand to officiate and welcome the more than 200 attending. A commemorative red maple was planted on site in honour of the Commonwealth Conference and a log sawing ceremony dedicated the new building.

Open House '86 was held in February, 1986, with close to 11,000 visitors attending over a six-day period. This was the first Open House in seven years (due to con-

struction program), and reaction by those attending was most rewarding. All staff participated and all projects were on display.

The retirement and transferring of several members of the Centre's Management Committee resulted in an almost complete new complement of managers. **Cliff Brown**, Deputy Director; **Dr. Doug Lacate**, Program Director, Forest Environment; and **John Ellis**, Administrative Officer all retired this year. As well **Dr. Tom Sterner**, Program Director, Forest Protection, transferred to our sister establishment in Fredericton — the Maritimes Forestry Centre.

Dr. Gordon Miller was appointed Program Director, Forest Protection replacing Dr. Sterner. Dr. Miller had served as a research scientist studying cone and seed insect problems at PFC prior to this appointment. **Dave Winston**, a program advisor at CFS Headquarters was appointed Program Director, Forest Environment and **Robert Dean**, Chief, Management and Administrative Services at the Great Lakes Forestry Centre transferred to the similar position at PFC. The Deputy Director position was eliminated during this reorganization.

Other new additions to the staff were: **Lee Humble**, insect and diagnostic taxonomic scientist; **Eleanor Gardner**, forest mensurationist; **Dr. Leslie Mitchell**, research scientist — biochemistry; and, **Robert Hagel**, superintendent of greenhouses and grounds. Several staff were appointed in support of FRDA activities including: **Steve Taylor**, prescribed fire research officer; **Roger Whitehead**, herbicide specialist; **Win Stokes**, Implementation Officer; **Rona Sturrock**, nursery pest specialist; **Wes Nicholson**, timber supply analyst; **Kelly Finck**, plantation pest management specialist; **Mark Atherton**, **Candace Laird** and **Walter Matosevic**, forestry development officers; **Deborah Barkhouse**, Information Officer and **Eleanor Stoffelsen**, weed control technician. **Wayne Coombs**, Silviculturist, British Columbia Forest Products, joined PFC for a two year period under the Interchange Canada Program.

Dr. Charles Dorworth, a senior forest pathologist transferred to PFC from the Great Lakes Forestry Centre, **Dr. Terry Shore** was promoted to a Research Scientist position and **Dr. Roy Shepherd** was promoted to Research Scientist 3.

Several staff members were on education leave including: **Donna Macey** at University of Alberta; **Al Mitchell**, University of Washington; **Paul Commandeur** at Oregon State University. **Dr. Stu Whitney** began a year's development leave at Boyce Thompson Institute of Plant Research, Cornell University, Ithaca, N.Y.

In an on-going process, about one-third of the Centre's projects underwent intensive review by committees representing the management of PFC, other scientists and members of the research community outside the Centre. Some projects were terminated with a view to placing more emphasis and resources on current priorities more in keeping with the changing mandate of the Canadian Forestry Service.

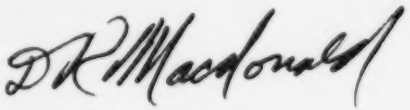
The 30 projects and over 150 studies conducted at the Pacific Forestry Centre are divided into four major areas.

Forest Environment. Federal responsibilities in the Forest Insect and Disease Survey and plant quarantine are carried out in cooperation with other federal and provincial agencies. Research includes ways to improve the Canadian Forest Fire Danger Rating System as it relates to British Columbia and Yukon, as well as investigating meteorological and hydrological influences on forest ecosystems. Environmental impact assessments of major construction projects are carried out.

Forest Resources. Research and operations studies involve land classification, improving quality and production of seedlings, and developing improved regeneration methods and silvicultural practices to enhance the productivity of coastal and interior forests. Federal responsibilities in seed certification and testing are carried out.

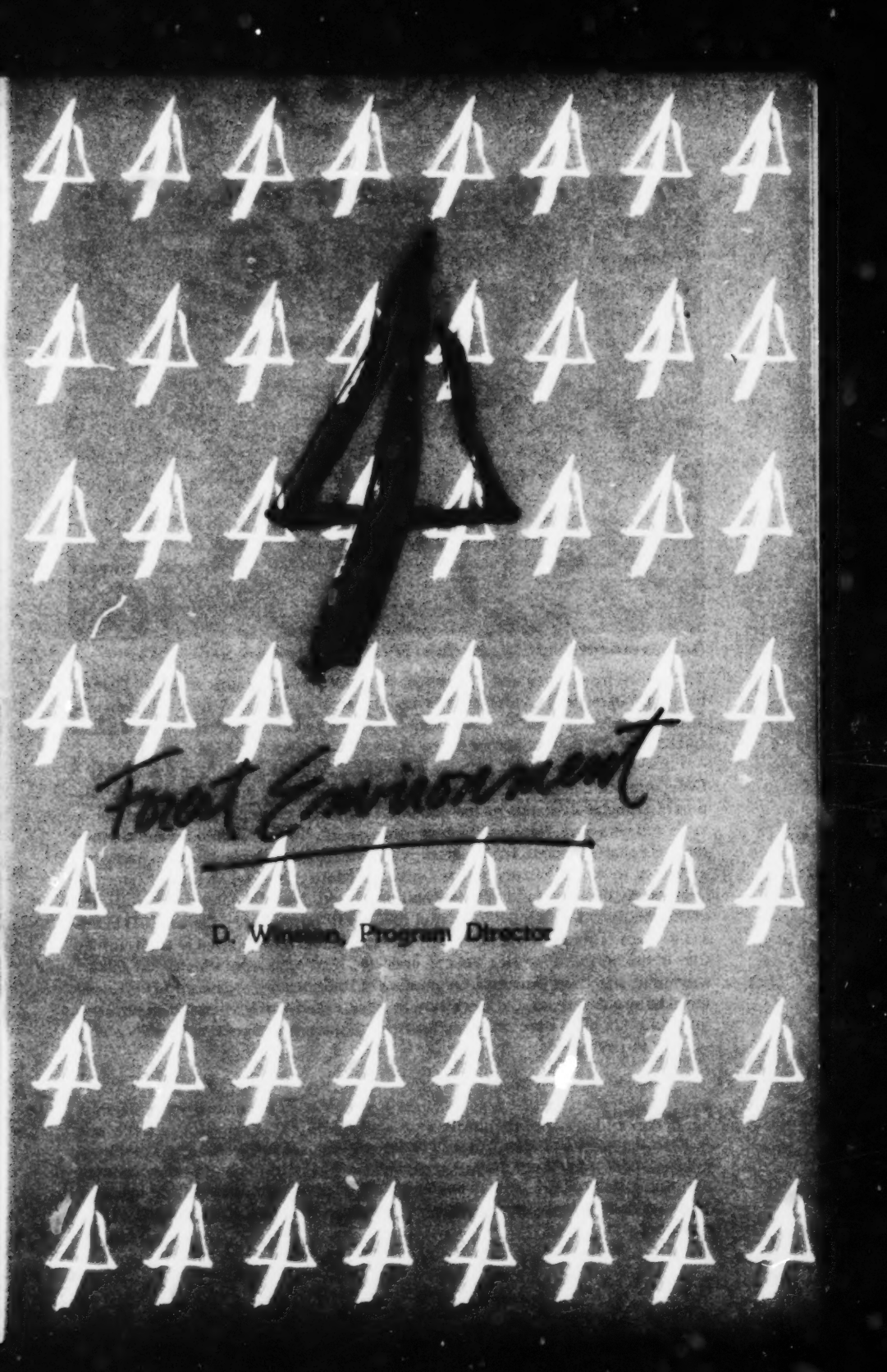
Forest Protection. Research and operations include studies of insect and disease influences and forest depletion, as well as development of pest management strategies and guidelines, and the development of guidelines for the recognition, control and prediction of growth of stem diseases.

Forest Development and Relations. As well as negotiating and administering the federal involvement in Canada — British Columbia Forest Resource Development Agreement, this group is active in planning activities for the Centre, technology transfer, managing forestry job creation programs, economic analysis and forestry relations and liaising with clients of PFC.



D.R. Macdonald
Director-General
Pacific and Yukon Region

March 31, 1986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Forest Environment
D. Winston, Program Director

Forest insect and disease survey

Project Leader: G.A. Van Sickle

Professionals: Dr. J.C. Hopkins, L. Humble

Technicians: R.J. Andrews, R. Duncan, R.D. Erickson, R. Ferris, R.W. Garbutt, N. Humphreys, H.P. Koot, J. Loranger, D.P. Lowe, E. Pass, A. Stewart, R. Turnquist, L.S. Unger, J. Vallentgoed, C.S. Wood.

Objectives

To provide part of an annual national overview of important forest insect and disease conditions, including "acid rain", and their implications. To conduct quarantine-related surveys and activities. To support research through maintenance of historical records, monitoring and reporting and when possible, providing requested collections and observations. To develop methods to measure pest-related tree mortality and growth losses, and to improve forest insect and disease sampling techniques.

Achievements

The annual monitoring and assessment of forest pest conditions in British Columbia and Yukon was conducted and results were published. The most damaging insect in western Canada continued to be mountain pine beetle with damage spread over 292 000 ha. Spruce beetle infestations declined to 15 800 ha.

Defoliation of Douglas-fir by western budworm increased threefold, while defolia tion of Douglas-fir stands by tussock moth virtually collapsed, as predicted due to virus and parasites. Western hemlock looper in the Nelson, Kamloops and Cariboo regions collapsed due to larval parasites and virus. Western blackheaded budworm expanded to 45 600 mainly on the Queen Charlotte Islands. Larch casebearer and larch sawfly declined but larch budmoth increased. Major problems in mature and immature forests continued to be root rots, dwarf mistletoes, rusts and canker diseases. Black army cutworm killed and severely defoliated seedlings in slash-burned sites in the northern interior. Several cone and seed pests were widespread and destroyed up to 82% of the cones. Quarantine related surveys for pinewood nematode terminal crook disease and larch canker were negative. Gypsy moth occurred at four sites. Six plots were established as part of the national acid rain early warning system, three in 1984.

Projections

A general survey in support of a national overview of important pest conditions will be conducted and reported. A compilation of 35 years of records of parasites of common insects of B.C. and a booklet on "Pests of Second Growth" are in preparation. A computer assisted mapping and analysis system is being developed and evaluated.

Mapping ponded water in a soil disturbance plantation.

Environmental effects of forestry operations

Project Leader: Dr. R.B. Smith

Professionals: Dr. E. Hetherington

Technician: E.F. Wass

Objectives

To identify, measure and explain the effects of harvesting and site preparation practices on forest environments and productivity to support existing good practices and develop new practices where required.

Achievements

A major paper describing results from a study of natural regeneration and forest productivity on landslides in the Queen Charlotte Islands awaits publication in the B.C. Ministry of Forests Land Management Report series. The same subject was the focus of two public lectures, a poster presentation at the Ecological Society of America Annual Meeting and was included in a PFC Open House display. A paper on soil disturbance and soil degradation was presented at the 10th B.C. Soil Science Workshop.

Two new soil disturbance plantations were established in the Interior, one in an area stumped for root disease control and the second in an area with major downhill skidroads. Tree survival and first-year growth measurements were made along with additional measurements of soil properties.

Soil disturbance surveys before and after a demonstration stumping operation were conducted near Duncan. Project members participated in the production of a video describing the operation and including some results of the surveys.

Projections

Project members will contribute to the Fish Forestry Interaction Program Symposium now planned for late in the 1986-87 fiscal year.

The downhill skidding soil disturbance plantation established in 1985 will have to be replanted as a result of low survival from last year's exceptionally hot, dry summer. A new plantation will be established near Shawnigan Lake in an area stumped for control of root disease. Monitoring of established plantations will be continued. Top and root measurements will be made in the fall on a sampling of trees in two five-year old soil disturbance plantations.

Fire research

Project Leader: B.D. Lawson

Professionals: B.C. Hawkes, S.W. Taylor

Technicians: G.N. Dalrymple, G.R. Lait, R. de Jong

Objectives

To develop fire behavior prediction systems for major fuel types, incorporating this knowledge within the Canadian Forest Fire Danger Rating System, a national framework designed to assist fire management agencies with forest resource protection. To develop methods and models to incorporate fire effects knowledge into land management practice in order to improve the application of prescribed fire to a variety of silvicultural problems.

Achievements

Cooperative work by the CFS Fire Danger Group, a national coordinating body of researchers responsible for developing the Canadian Forest Fire Danger Rating System (CFFDRS), continued on several fronts. The second year of a three-year field study of fire spread in boreal black spruce in northern Alberta was completed with cooperation from three CFS regional centres, the national forestry institute and the Alberta Forest Service (AFS). Seven experimental fires were conducted

in 1985. When the study is completed, results will be incorporated in the Canadian Forest Fire Behavior Prediction (FBP) System, which is currently being implemented by regional fire management agencies, following user-trials and training over the past year. Rate of spread equations are now available for 14 Canadian fuel types.

Prescribed fire research achievements included demonstration and publication of a monitoring methodology handbook for documenting prescribed fire behavior and impact assessments. This is a cooperative study by CFS and BCFS sponsored by FRDA. CFS scientists initiated a second FRDA-sponsored study on the use of prescribed fire in rehabilitation of failed plantations and brushfields in the subboreal spruce zone of Prince George and Cariboo Forest Regions. Coastal prescribed fire and fire effects studies continued on several fronts, including a cooperative venture with MacMillan Bloedel Ltd. to study the effects on plantation establishment and growth following fire of various intensities on coastal cedar-hemlock sites. Four burns were conducted by MB and monitored by CFS and MB, with followup studies of planted seedlings scheduled for the next five years. Contract studies with UBC on prescribed fire effects on nutrition and growth of coastal plantations and natural cedar-hemlock regeneration and interior spruce plantations continued or concluded, with publications in preparation.

Technology transfer of research results concerning both the CFFDRS and prescribed fire research took place by way of four symposium papers, training courses for BCFS, Yukon Forest Service, Atmospheric Environment Service, prescribed fire workshop presentations for BCFS and Industry, and guest lectures at UBC Faculty of Forestry and U. Victoria Biology Dept.

Projections

The experimental fire study in lowland black spruce sponsored by NoFC and AFS, will conclude in 1986, with PFC again cooperating. The CFS Fire Danger Group is now actively preparing for publication of the FBP System and for national technology transfer of this new system geared to fire management decision-making. In addition to rate of spread predictions for new fuel types, future work involves fuel consumption and fire intensity predictions to assist in fire preparedness and initial attack planning.

The main thrust over the next four years in prescribed fire research is the CFS study sponsored by FRDA on spruce site rehabilitation opportunities and prescription development. However, work will continue on interior spruce current logging site preparation prescription development, and coastal prescribed fire effects research on cedar-hemlock sites.

Environmental assessments

Project Leader: Dr. W. Stanek

Objectives

To fulfill the Pacific Forestry Centre's responsibilities in the Environmental Assessment and Review Process (EARP) including acquisition of baseline data and reporting in relation to environmental matters.

Achievements

The following tasks were performed: reviewed environmental impact statements in the gas pipelines (Alaska Highway and Dempster Highway), oil pipelines (Trans Mountain's, Foothill's Skagway and overland routes, and Kitimat's), and Shakwak Highway Improvement, Queenstake Dredging Proposal and Foothills' Revegetation Program for Alaska Highway and Dempster pipelines. Consultations (Liquefied Natural Gas, Yukon placer mining, IBP reserves, logging, pollutants) and specialist witnessing (EARP Hearings, Whitehorse, in 1978 and 1979) were provided; many confidential reports and reviews (DOE Task Force; Northern Pipeline Agency) were written.

Three major reports on vegetation types along the Alaska and Dempster Highways were completed, and "Ecotour from Kamloops to Golden" was published.

"Drunken trees" on thawing permafrost, Yukon, near Whitehorse.

Complied with request by DINA for consultation re environmental studies of the proposed Stikine River dam site and the Tahltan land claim area, work which had been commissioned by the Tahltan Indian Band Council; contributed to assessment of the proposed Peace River and Keenleyside-Murphy hydroelectric developments; partook in several inspections and meeting of the Environmental Committee dealing with the CPR double tracking in the Glacier National

Park; continued as member of the Northern Pipeline Task Force, Acid Rain Committee and LNG Task Force. Completed soil survey report and four pH distribution maps dealing with the proposed Dempster pipeline corridor. Reviewed many internal and external scientific reports. Provided Technology Transfer to the Peatland Subcommittee of the NRC of Canada. Major contributions were made toward developing a proposal to study the impact of air emissions on the first environment from the Hat Creek coal-fired, electricity generating plant.

The revision of the PFC plantation record is completed except adjustments arising from the construction of the PFC addition. Report on "Terminology of Peat and Peatlands" was published. A preliminary report on forest ecosystem classification along the Alaska Highway, Yukon Territory, was submitted for inclusion into the Proceedings, I.U.F.R.O. Site Classification Workshop, Fredericton, N.B., October 7-10, 1985. Prepared a report on resinosis in lodgepole pine initiated by Atropellis canker.

Projections

Continue compilation of material for a Sitka spruce monograph. Continue representing CFS in the Environmental Assessment and Review Process. Provide technology transfer, and function as Scientific Authority in contracts. Provide input into Study PC-32-921 "Public awareness and Grounds Improvement" and PC-02-404 "Mensurational Input into Pest Damage Assessment". Forest ecosystem classification field guide for the Alaska Highway area, Yukon Territory will be completed.

Meteorology in forestry

Project Leader: Dr. R.H. Silversides

Technician: R. Benton

Objectives

To acquire and apply meteorological knowledge to assist in the solution of forestry and environmental problems in the Pacific Region. In the shorter term, to develop and test one or more models which simulate climatic influences.

Achievements

Field observations have been completed for the Inland Spruce Cone Rust and Mountain Pine Beetle Dispersal cooperative studies. Analysis of the data continues.

A listing for the Fosberg 3-dimensional wind model has been obtained and will be tested using the PFC VAX facility.

Measuring winds with a balloon-tracking theodolite.

Climate data are being organized and analyzed using the SAS statistical package.

Projections

A new cooperative study with Fire Research, approved as a FRDA cost-shared study, will examine seedling growth and development on backlog NSR sites rehabilitated using prescribed burning. Seedling microclimate will be examined as part of this study.

An instrumented tower will be established at Shawnigan Lake to serve as a testbed for instruments and help in obtaining background climate information for the Shawnigan Lake site.

A wind tunnel and insect test flight facility is being built at PFC. One tunnel will be used for calibrating instruments and for modelling wind flow problems. Other tunnels will be used for testing pheromones and insect flight behavior.

Carnation Creek experimental watershed

Project Leader: Dr. R.B. Smith

Professional: Dr. E. Hetherington

Technician: R.J. Rowswell

Objectives

To integrate and conduct forestry, hydrology, vegetation and soil studies at Carnation Creek for use in the development of appropriate forest harvesting practices for coastal salmonid-producing watersheds.

Achievements

Monitoring of summer, valley-bottom groundwater levels and fog-drip precipitation and data collection at the steep slope, subsurface stormflow study were continued. Dr. G.M. Aubertin returned for a 5-week visit to continue work on the subsurface stormflow data.

Annual revegetation assessments were completed for 63 plots in 2 units as per the long-term monitoring plan. Plots in densely revegetated areas were relocated and marked to facilitate future remeasurement.

Dr. Hetherington submitted a chapter on "The importance of forests in the hydrological regime" for publication in a book sponsored by the Rawson Academy of Science on Canadian Aquatic Resources. A more extensive 120-page report on which the chapter is based was completed and prepared for review.

Projections

Summer groundwater measurements will be monitored in the valley bottom and further subsurface flow measurements and experiments conducted. Slope hydrology reports will be prepared. Thirteen vegetation plots will be remeasured according to the study plan. Papers will be presented by Project members at a Carnation Creek Symposium proposed for January 1987.

Pest damage appraisal

Project Leader: Dr. R.I. Alfaro

Professional: Dr. Y.J. Lee

Technicians: R.G. Brown, E. Wegwitz

Objectives

To understand and describe the damage caused by insects and diseases to the forest resource. To determine relationships between the level and duration of pest populations with the loss of growth or mortality of trees and stands. To investigate, in cooperation with other CFS projects, new technologies for the measurement of damage caused by forest pests. Information generated by this project are a prerequisite to sound pest management.

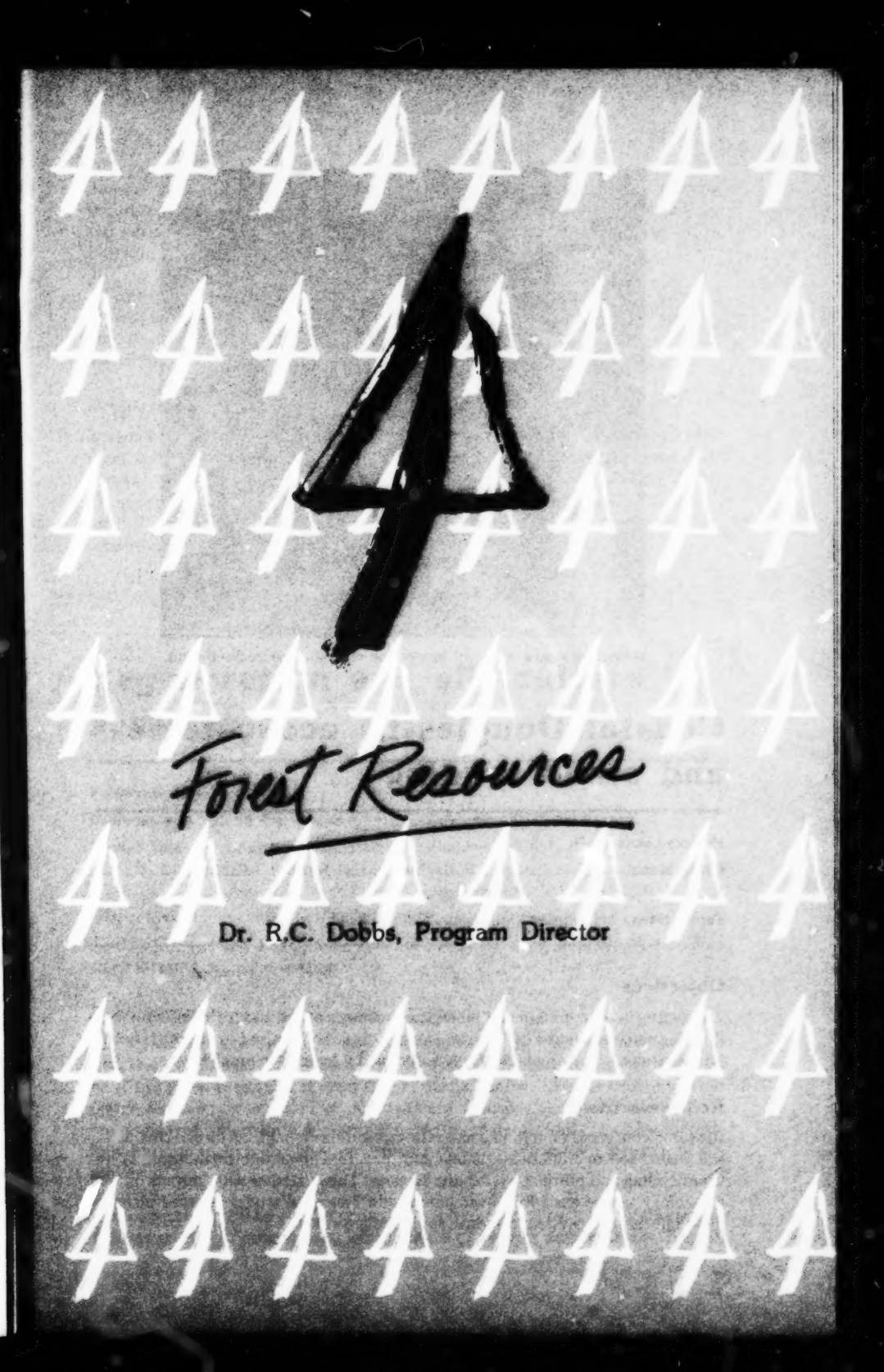
Achievements

Measurement of permanent plots to monitor pest levels and damage by tussock moth, budworm, western false hemlock loopers and spruce weevil, continued. Impact of the 1970's budworm infestation in the Fraser Canyon and Pemberton area was calculated; a report is in preparation.

Impact of the 1982-1984 Douglas-fir tussock moth infestation in the Kamloops district was calculated (in cooperation with BCMF). Data analysis continued to determine long-term impacts of the 1973-1975 Douglas-fir tussock moth infestation in the same area. Damage monitoring continued in Douglas-fir forests defoliated by western spruce budworm and sprayed with chemical insecticide in the Kamloops Region.

Projection

Existing damage appraisal permanent plots will again be measured; data analysis on tussock moth impact, to obtain per-hectare growth losses will continue. Measurement of field samples collected to estimate growth losses in Douglas-fir caused by the western false hemlock looper in the Chase area will continue. In cooperation with FIDS, permanent plots will be established to monitor impact of western spruce budworm defoliation in the Kamloops area.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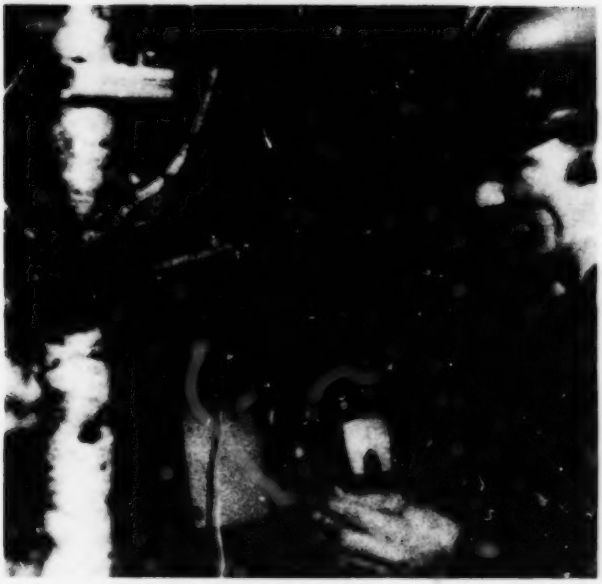
Forest Resources
Dr. R.C. Dobbs, Program Director



Measuring stem growth with an electromechanical dendrometer band.

Coastal Douglas-fir ecosystems and stand tending

Project Leader: Dr. H. Brix

Professionals: Dr. H. Barclay, E.R. Gardner, Dr. V.G. Marshall, A.K. Mitchell, Dr. P.C. Pang, Dr. T. Trofymow

Technicians: M. Clayton, C.R. Layton, K. McCullough

Objectives

To investigate tree growth and biological processes of soil and trees in response to thinning and fertilization of a coastal Douglas-fir ecosystem and to use the resulting information to develop a biologically based model for growth prediction.

Achievements

Research continued on thinning and nitrogen fertilization effects on soil chemistry, soil water, soil microflora and fauna and their functional interrelationship in nutrient cycling and nutrient availability to trees. This, together with impacts on tree physiology, is the basis for development of a biological model of stand management effects on ecosystem response and stand growth.

Reports were prepared on results from the Shawnigan trial concerning thinning and nitrogen fertilization effects on 12-year growth response, biomass distribution, and soil and tree water stress. Other reports dealt with effects of high level of fertilization and with nutrition of Douglas-fir.

As part of studies on nutrient cycling in relation to stand treatments the nutrient content of different tree components and of litter fall have been analyzed and further studies on the role of microflora, soil fauna and environment on litter decomposition are underway.

Projections

A report on our model SHAWN of ecosystem changes in relation to stand treatment will be published and further results from Shawnigan, particularly those dealing with nutrient cycling, will be incorporated into the model. Another model being developed deals with soil water budget under different levels of stand thinning. These models will serve in growth response prediction under different site conditions.

Regeneration and silviculture systems

Project Leader: J.T. Arnott

Professionals: Dr. S. Eis, D. Macey, Dr. R.G. McMinn

Technicians: D. Beddows, D. Craigdallie, G.J. Goodmanson, M.A. Grismer

Objectives

To develop, test and demonstrate new nursery systems and improved methods of stand establishment and tending.

Achievements

The second series of high elevation species and stock type trials, run in cooperation with the B.C. Ministry of Forests, were appraised to determine seventh year survival and growth response of eight species planted in two series of experiments in upper elevation ecosystems of southwestern British Columbia. This study is providing lead information on whether noble fir, an exotic to B.C., can be successfully introduced to high elevation ecosystems in the southwestern region of the province.

Assessments continued on the series of inverted mounding trials established in 1983/84 on a wide range of test sites in the B.C. Interior near Smithers, Fort St.

Fast growing Noble fir plug stock on high elevation cutover on Northern Vancouver Island; 3 meters tall after 10 years.

John and Prince George. The objective is to determine if white spruce, planted on inverted humus mounds, with a range in depths of mineral soil capping, will improve the growth rate of white spruce seedlings. Associated research on alternative white spruce stock types alone, and in combination with site preparation treatments, continue on spruce/subalpine fir sites in the Prince George Region.

A study to understand the development and inter-relationships of root, stem and crown growth of Douglas-fir, western hemlock and western red cedar is nearing completion with two publications in press. This information will add to the knowledge base for predicting tree growth responses resulting from stand tending practices.

Under contract, further study was completed on the auger planting trial of lodgepole pine on forest landings in the Fort St. James area. Soil bulk densities, soil chemical data (pH, N, P, K, C), and foliar nutrient data were measured on and off landing to determine what impact the landing site has on soil physical and chemical properties and their subsequent effect on growth of planted seedlings.

Research in support of container seedling nursery operations continued with investigations into the effect of split photoperiod lighting treatments on the growth of white spruce, Engelmann spruce, mountain hemlock, western hemlock and Interior Douglas-fir. The efficacy of metal halide light sources for photoperiodic lighting of these same species was also investigated. D. Macey's graduate research at the University of Calgary is investigating the annual changes in endogenous phytohormone levels and the associated metabolic activities that define specific developmental states in the shoot apex of coniferous seedlings. Thereafter, bud induction and morpho-genesis will be attempted through applications of growth regulators.

In cooperation with the B.C. Ministry Forests, field evaluations continued on western hemlock stock type trials at Nitinat Lake where the influence of chemical root pruning in the nursery is being followed in the field to see what impact this treatment has on early growth rates and root form of this species.

The Douglas-fir levels-of-growing-stock (LOGS) cooperative study at Shawnigan Lake and Sayward Forest continued on schedule with one and three treatment periods being completed at these respective study sites. The CFS study site data

has been incorporated into an across-site analyses of the response of Douglas-fir to repeated levels of thinning throughout its range. This compendium of results will be published in 1986 by the Pacific Northwest Forest and Range Experiment Station of the U.S. Forest Service, Olympia, WA.

Projections

All comparative stock type and site preparation trials in coastal and interior B.C. will be maintained, measured and results reported at appropriate intervals. From this extensive data base, stand modelling research studies will be used to predict what effects the various stock type/stand establishment practices have on the long-term growth and development of these plantations.

The other main initiative in this project over the next five years will be physiological research to improve stock quality and stock-quality testing in container seedling nurseries and a greater emphasis on physiological evaluation of seedling growth responses in the field.

Cone forecasting, seed quality improvement and certification

Project Leader: Dr. D.G.W. Edwards

Professional: Dr. S. Eis

Technicians: D. Craigdallie, F.T. Portlock and D.W. Taylor

Objectives

To enhance the quality and quantity of forest tree seeds supply in British Columbia and the Yukon Territory by improving methods of cone crop forecasting, seed procurement, processing and utilization. To develop and provide essential services for the movement of seeds in international trade.

Achievements

Seed utilization research continued to investigate the so-called "IDS" (incubation-drying-separation) method of separating germinable and non-germinable conifer seeds, with some encouraging results. For white spruce, separation in some seedlots was easier before the seeds had been stratified while in others, sorting was more effective after stratification. Efforts to find a method of carrying out the IDS process on a practical scale were only partially successful and no definite methodology emerged. This work will be emphasized in 1986-87. Studies on germination in western white pine showed that compound (warm followed by cold) stratification produced markedly better results than the application of a surface sterilant fol-

Registration of the first North American forest seed orchard under the OECD seed certification scheme.

lowed by cold stratification, but experiments on controlling seed moisture content during stratification were inconclusive.

The data base from which rating standards for cone crops will be developed continued to be expanded by counting reproductive buds during late winter in selected stands, and assessing the size of the subsequent cone crop in the following autumn. Guides to interpreting reproductive strategies were published for four additional species for inclusion in the manual "Reproduction in conifers", bringing the total to 18. A guide to whitebark pine will be published in 1986.

Official seed certification and testing services, under the OECD Scheme and ISTA Rules respectively, continued to be provided for seeds moving in international trade. Following the 1985 expansion of the OECD Scheme to include untested seed orchards, three British Columbia orchards were registered and over 100 kg of orchard seeds were certified. The Project Leader attended the biennial OECD meeting of Designated Authorities in Paris, France. Regulations for Forest Tree Seeds, to accompany the Seeds Act of Canada, reached a penultimate draft, and the manual for testing tree seeds, to become an appendix to the Regulations, was completed and will be published in 1986. Advice and liaison services on problems concerning seeds, pollen and other reproductive materials, were provided to meet requests. A series of lectures on reproductive mechanisms in trees were given in the Philippines and Thailand by Dr. Eis, who also taught crop prediction and reproductive bud recognition at a Canadian Workshop for provincial industrial field forestry personnel.

Projections

The feasibility of upgrading conifer seedlots on a practical scale by manipulating

differences between viable and non-viable seeds to retain moisture, will continue as the major thrust of the seed improvement research. However, investigations on methods to improve germination in western white seeds will be expanded. A description of the morphological characteristics of reproductive structures of limber pine will be added to the "Reproduction of Conifers" manual.

Forest land productivity

Project Leader: Dr. E.T. Oswald

Professionals: Dr. T.G. Honer, Dr. Y.J. Lee

Technicians: B.N. Brown, J.F. Dronzek

Objectives

To conduct field assessments and prepare reports on forest productivity, vegetation succession and classification of the forest resource in Ecoregions 1-14; to provide data to the national forest inventory of Canada; to monitor vegetation succession following recent burns; to develop functional computer based information storage and retrieval systems; and to test and utilize remote sensing technology for forest classification.

Achievements

Forest cover typing at a scale of 1:250,000 was completed for Ecoregions 1-14, including photointerpretation and ground verification, and the data is being compiled for the national forest statistics program. Field assessments for forest productivity and plant succession were conducted in Ecoregion 2 (Watson Lake). To

Fires severely damage forests, especially through repeated burnings, as illustrated by the remains of this young stand.

date, 53 plots have been established in five burns, and nine control plots in surrounding unburned forests were established. Fifth year assessments were made on two burns and third year assessments on the other three burns. Seeds of white spruce, lodgepole pine, bristle cone pine and Siberian larch were obtained and are being germinated for out planting in selected sites near Whitehorse and Watson Lake. Computer data handling systems have been developed for storing and analyzing data; of particular significance is the system for handling forest cover data. Volume estimates were developed for Ecoregions 1 to 5 and 14. Two publications pertaining to the forest resource and remote sensing were produced. Project staff actively participated in national working groups on forest statistics, wetlands, vegetation classification, and ecological land classification.

Projections

Maintain up to date computer files on forest statistics, and increase capability of Yukon RRAMS; remeasure permanent plots for vegetation and tree growth, and establish additional plots in newly burnt areas; conduct field examinations to obtain data on forest cover, productivity, biomass, and vegetation succession; plant exotic tree seedlings on a variety of sites and monitor their development; establish permanent benchmark forest plots and analyze their characteristics; evaluate new remote sensing technology; and participate in national working groups, symposia, and conferences.

Fertilizers applied on snow

Project Leader: Dr. V.G. Marshall

Professionals: Dr. E. Hetherington, Dr. P.C. Pang

Objectives

To conduct field and laboratory experiments for assessing nutrient losses from application of urea and ammonium nitrate and to develop a decision-logic table for applying these fertilizers to forest soils.

Achievements

N-isotope analysis continued on plant specimens, leaving the last 1300 samples to be completed. The project was evaluated by a CFS-Headquarters panel that recommended, as an immediate priority, completion of chemical analysis on plant materials and preparation of reports on the data already collected.

Projections

All 38 field plots will be remeasured for 3-year growth response to fertilizer off and on snow. A report to the BCMF and scientific papers to journals will be prepared as statistical analyses are completed. The remaining field work of the project will be consolidated into a single study.

Travelling to the plots by snowmobile.

Supporting services

Chemical services

Project Leader: A. Van Niekerk

Objectives

The chemical services laboratory provides, on a continuing basis, chemical analysis of soil, sediment, plant material and water for research studies of P.F.C.

Achievements

A number of research scientists submitted samples for analysis, from their studies.

Included were, rainwater, canopy litterfall and permanent sample tree foliage from studies of nutrient cycling in young Douglas-fir ecosystems.

Another study included analysis of foliage to assess field performance of new stock types.

A larger number of soils were submitted and analyzed from sites being studied for tree establishment, survival and productivity after fires; from sites affected by forestry practices and from N.S.R. sites within the Pacific & Yukon region.

Soil sample analysis for total carbon using an LECO CR 12 analyser.

Maintenance activities included the monitoring of nutrient solutions and soil mix quality for greenhouse trials. New instrumentation, available for inorganic chemical analysis was installed and calibrated to replace some of the outdated techniques.

Projections

A wider scope of analysis to include additional test parameters is anticipated with the firm establishment of the chemical services facility. Several cooperative studies with outside agencies are planned as well as an increased number of sample analyses requests from studies within P.F.C.

Computing and statistics

Project Leader: J.S. Partridge

Professionals: S. Alers, S. Moncrieff, Dr. J. Pannekoek, Dr. C.S. Simmons

Technicians: J. Foster, M. Henderson

Objectives

To provide computing equipment, software and statistical services and computer operational support for the scientific and administrative programs in the Pacific Forestry Centre.

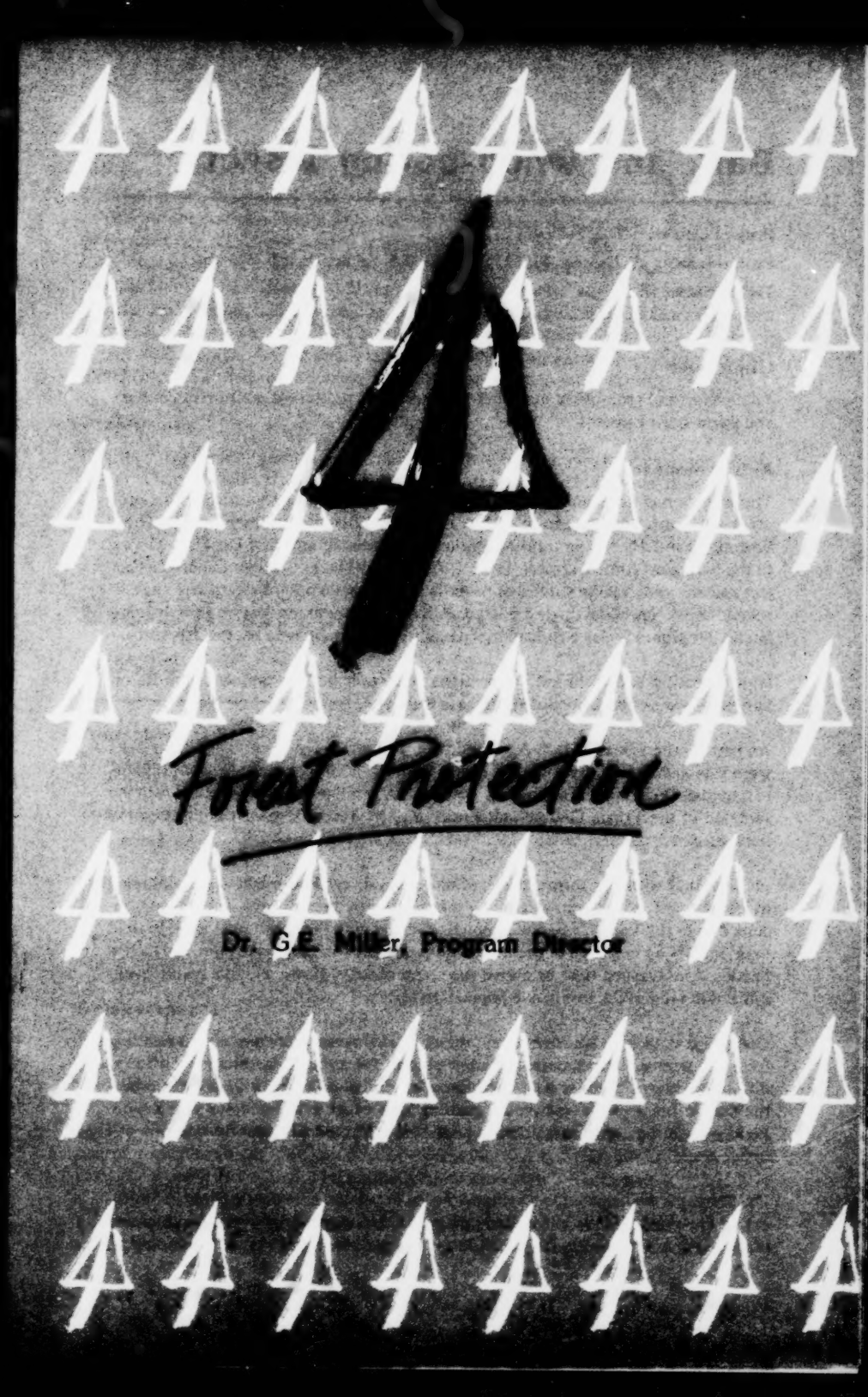
Achievements

In 1985 further steps were taken to modernize and improve the efficiency in the work place by using more computing equipment and replacing old inefficient computing equipment. Significant work has been done to support the incorporation of computer technology in several laboratories allowing for the development of new analytical methodologies and, in some cases, automated data acquisition. The Pacific Forestry Centre purchased software, laser printers and new word processing equipment to begin implementing a computerized office management system.

Projections

Computational and Statistical Services plans to continue to keep the computer hardware and software up to date and functioning satisfactorily. New computing equipment and software will be purchased and new software will be written to support scientific research and to improve productivity in the administration offices. In addition, Computational and Statistical Services will be providing both scientific and administrative computer users with assistance and a consultation service for hardware, software and statistics.

Statistical Services will examine the need to reduce the number of statistical packages maintained on the computer system and will re-train computer users for any new statistical packages.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Forest Protection
Dr. G.E. Miller, Program Director

Bark and wood-boring insects

Project Leader: Dr. L. Safranyik

Professionals: E. Gardner, Dr. T.L. Shore, Dr. T.S. Sahota, Dr. H.S. Whitney

Technicians: R.E. Betts, A. Ibaraki, D.A. Linton

Objectives

To develop and promote management guidelines to reduce losses from major bark and wood-boring insects.

Achievements

The project has undergone major changes in research personnel during this program year with the retirement of Dr. L.H. McMullen, secondment of Dr. D.M. Shrimpton to CFS HQ on term assignment, and reassignment of Dr. H.A. Moeck to the biological control project. Dr. T.L. Shore and Ms. E. Gardner joined the project and are undertaking studies of mountain pine beetle hazard rating systems and related work specified in the Canada/USA Agreement on the mountain pine beetle. Dr. Shore is also a co-leader of a study on mountain pine beetle dispersal.

Nine scientific and technical publications were prepared by project scientists on various aspects of bark beetle problems and control.

As part of the Canada/USA Agreement on mountain pine beetle, 48 field plots were established in lodgepole pine in the Cariboo, Kamloops and Nelson Regions to evaluate existing hazard rating systems. A similar number of plots will be sampled in the Prince George and Prince Rupert Forest regions during the next field season.

Field studies with two formulations of pine oils, sprayed onto baited and unbaited lodgepole pine, to prevent attacks by mountain pine beetle, gave inconclusive results due to the very low beetle population levels in the experimental area. In field experiments on dispersal of the mountain pine beetle in lodgepole pine, only a few beetles were trapped near or above the stand canopy. However, this result is significant in view of the low beetle population levels.

Cell image data from spruce beetles taken from a downed tree, unstressed standing tree, and stressed-standing tree, were analysed. All three groups showed distinctly different patterns. Similar data from five experimental (laboratory) populations of the spruce beetle were analyzed, resulting in a paper submitted for publication. Field populations of mountain pine beetle were located for reproductive and cell image work in 1986-87.

Dr. Safranyik participated in a symposium on mountain pine beetle (held in Smithers, B.C., April 17-19, 1985) and presented two papers on beetle biology and management. Drs. Safranyik and Shore participated in a workshop on mountain

pine beetle control in Williams Lake B.C., to assist protection personnel with development of a control strategy. Drs. Safranyik and Shore hosted Dr. Jim Stewart, Chief of Forest Protection, USDA Forest Service, on a 10-day tour and discussion of pheromone control sites for mountain pine beetle management. Drs. Safranyik, Shore and Ms. Gardener hosted a delegation of the North American Forestry Commission on a tour of mountain pine beetle infestations and research sites in the Cariboo Forest Region. Dr. Safranyik has also presented a paper on mountain pine beetle epidemics and management. Drs. Safranyik and Shore gave a talk on bark beetle research at PFC to a Chinese delegation and management staff of West Fraser Mills Ltd. Dr. Safranyik has talked to the economic entomology class of the University of Victoria regarding bark beetles and related research at PFC.

Projections

Publish management guidelines for the spruce beetle; continue studies of mountain pine beetle dispersal and hazard rating systems attacks on individual trees.

Biological control of forest pests

Project Leader: Dr. M.A. Hulme

Professionals: Dr. J.W.E. Harris, Dr. H.A. Moeck, Dr. I.S. Otvos, Dr. R.F. Shepherd, Dr. H.S. Whitney

Technicians: T.G. Gray, C.M. Macdonald, M. Talmon de l'Armée

Objectives

To evaluate the use of natural enemies as control agents for forest pests and, where appropriate, incorporate natural enemy manipulations into forest pest management strategies.

Achievements

Populations of winter moth near Victoria continue to decline as parasitism by the parasitic fly and parasitic wasp introduced around 1980 continues to increase. Pest damage of oaks and fruit trees has decreased markedly.

Monitoring of parasitoids introduced during the past 10 years to control larch casebearer was intensified. Two parasitoids are established but their effect on larch casebearer populations cannot be estimated until more data are collected.

Following our observations that some mountain pine beetles could die quickly by infecting themselves with spores of the fungus *Beauveria bassiana* dusted onto the

A parasitic wasp laying its egg in the egg of Douglas-fir tussock moth.

bark of lodgepole pine trees, ten different isolates of the fungus have been obtained and cultured to see which causes the highest beetle mortality.

Field surveys on the native insect enemy complex of the Sitka spruce weevil and of the mountain pine beetle are in progress, to provide data on natural biological controls prior to any planned intervention with biological control agents.

An important aspect in manipulation of insect enemies is utilisation of the kairomones that attract the insect to its target. A literature review has been completed on the state of the art in insect manipulation with kairomones.

Projections

Natural enemy introductions against several forest insect defoliators will continue to be monitored to establish the impact of the introduction on pest damage. Testing will begin with ten isolates of *Beauveria bassiana* to establish which causes the highest mortality to mountain pine beetle when spores are picked up by the insect from lodgepole pine bark. Experiments will be undertaken to rear some of the insect enemies isolated from Sitka spruce weevil and mountain pine beetle. The kairomones that some of the insect enemies use will also be investigated.

Root diseases

Project Leader: Dr. W.J. Bloomberg

Professionals: K.E. Finck, G.D. Jensen, Dr. Y.J. Lee, Dr. D. Morrison

Technicians: D. Chu, A. Hall, A.L.S. Johnson, G. Reynolds

Objectives

To define the epidemiology and impacts of root diseases in second-growth stands; to develop control strategies; to expedite application of research results, and to act as resource personnel and/or project leaders on Forest Resource Development Agreement (FRDA) projects related to root disease.

Achievements

A biologically realistic computer simulation model of *Phellinus weirii* root rot has been developed using B.C. and Oregon data. Test results for model accuracy are highly encouraging. The model incorporates all phases of disease development including: inoculum distribution and infectivity; host tree root growth and spatial distribution; root contact with inoculum and other infected tree roots; root infection and spread of the disease throughout root systems; tree growth reduction and mortality with increasing root decay.

The model produces estimates of stand growth losses given various levels of inoculum, tree growth rates, tree species mixtures and stand densities over the rotation period. The effect of silvicultural treatments on disease impact can be simulated. Possible treatment inputs include spacing, pre- and post-commercial thinning, infected stump removal, and sanitation cuttings.

Stump extraction to control *Phellinus* root disease.

Integration of this model with the B.C. Ministry of Forest's growth model TASS will be completed during the coming year.

Research continued on the ecological relationships of *Phellinus* root rot. Initial analyses have shown strong relationships of the disease to soil moisture regime and to a lesser extent nutrient status.

A study was begun on the relationship between the genotype of selected Douglas-fir plus tree crosses and their tolerance to *Phellinus* root rot. The objective is to identify parentage which is associated with either very high or very low disease tolerance as a basis for developing trees with increased disease tolerance for areas with high root rot hazard.

Work was begun to determine the influence of stump species and stump surface area on spread of the fungus *Fomes annosus* from colonized spacing stumps to adjacent leave trees. A computer program was developed to compute total and diseased root and stump volumes. Eight colonized hemlock stumps were excavated and analyzed.

Progress was made on using large-scale colour infrared photography for the identification of root disease centres and in volume loss surveys. The feasibility was investigated for analyzing digital data from colour infrared aerial photography on a Perceptron Image Analysis System for distinguishing root disease centres, rate of spread, and for rating stands for disease severity.

A root rot demonstration site was established on the Cowichan highway near Duncan in cooperation with MacMillan Bloedel Ltd. and funded under FRDA. Stump extraction and species trials are visible from a trail through the site. Assessment of site impact, species resistance trials and studies on the effectiveness of stumping as a control for *Phellinus* root disease will be conducted over the next several years. A video tape on control of *Phellinus weirii* was produced during the establishment of the demonstration site.

A FRDA research project on root disease in the interior drybelt region was completed. Part one of this 2-part project involved ground mapping infections of root disease in three areas. Survey methods were then tested to determine the most appropriate survey for estimating root disease infections in interior drybelt stands.

The second part of the project involved site assessment of backlog areas to determine indicators of root disease suitable for use during regeneration surveys. The incidence of root disease was noted concurrently and the possibility of developing a hazard rating system was investigated.

Several FRDA proposals are currently under review. Topics include using the herbicide *Round-up* as a control for *Phellinus weirii* and the development of a dwarf mistletoe demonstration area.

A new addition to the protection staff is Kelly E. Finck, who was hired under

FRDA as a Plantation Pest Management Specialist. Mr. Finck is working with Dr. Bill Bloomberg and is involved in FRDA projects, technology transfer and research related to plantation pests.

Projections

To supply forest managers with guidelines for recognition, risk assessment, impact estimation and control strategies for the major root diseases. In the coming years FRDA will increase the opportunity to meet the objectives of this program.

Regeneration pests

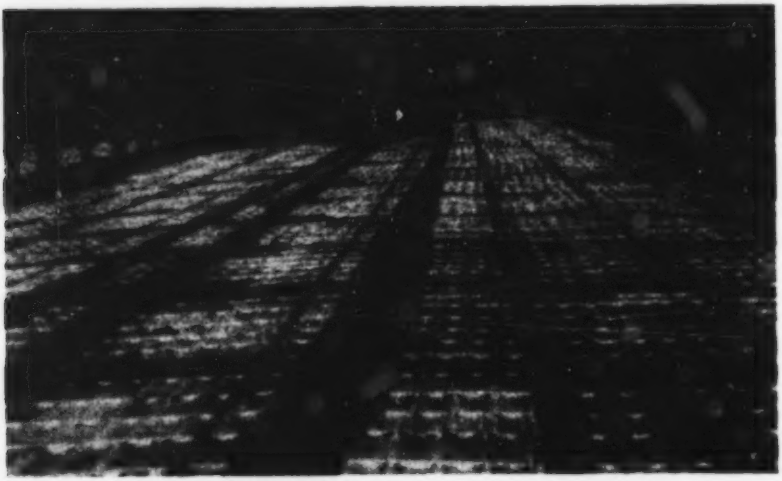
Project Leader: Dr. J.R. Sutherland

Professionals: Dr. A. Funk, Dr. R.S. Hunt, Dr. M. Meagher, Dr. G.E. Miller, Dr. L.A. Mitchell, Dr. T.S. Sahota, Ms. R.N. Stewart, Dr. E.E. White

Technicians: H. Craig, J. Dennis, D.S. Ruth, T.A.D. Woods

Objectives

To identify the major insect and disease pests of forest nurseries, seed orchards and reforested areas. To develop pest management strategies to keep the incidence of these pests below economic thresholds. To develop techniques that allow early detection and meaningful predictions regarding the pests. To assist in transferring new technology developed as a result of this research.



New pest problems are being encountered in container nurseries.

Achievements

As a result of the recent signing of the Canada/British Columbia Forestry Development Agreement, reforestation programs in the Province will increase even more in the coming years. Such programs will increase the needs for high quality seeds and seedlings and successful survival and growth of outplanted stock. To achieve the reforestation goals, pest-caused losses in seed orchards, forest tree nurseries and young plantations must be kept at a minimum. Scientists and technicians in the Regeneration pests project will play an important role in both technology transfer and in doing research that minimizes reforestation diseases and insect losses. In fiscal 1985-86, project scientists published 28 scientific papers/symposia proceedings plus 10 abstracts. Nineteen seminars/lectures were presented to scientific audiences, forest managers and students, the latter in British Columbia universities and technical schools. Project scientists served on the committees, often directing the research, of nine graduate students. Cooperation remained especially good between project staff and user agencies including the B.C. Ministry of Forests and both public and private companies. As in the past, technology transfer continues as a strong component of the project, e.g. project personnel dealt with 344 requests for diagnoses and pest management recommendations. Among these requests there were 236 from forest nurseries, 43 on diseases in seed orchards and young plantations. Cones from seven seed orchards were assayed for cone and seed insects and the results were used in reducing losses from these pests. In addition, such surveys help reduce pesticide usage in seed orchards. In other developments, late in the year Dr. L.A. Mitchell, previously a NSERC PDF with Dr. Sutherland, joined the C.F.S. and this project on a full-time basis as did Ms. Rona Stewart, nursery pest specialist. Dr. E. White spent three months at the University of Umea in Sweden. Project scientists served as scientific authorities for six contracts (over $450,000) for research funded through FRDA and Supply and Services Canada.

Some research highlights included the development or discoveries of two sensitive immunoassays — an indirect enzyme-linked immunosorbent assay (ELISA) and a dot immunoassay — for use with *Sirococcus* — specific monoclonal antibodies. Both assays were successfully applied to detect *Sirococcus* in spruce seed extracts (Dr. Mitchell). Trapping procedures using a sex attractant for Douglas-fir cone moths (Dr. Miller) were developed. Approximately 140 canker-free (free of white pine blister rust) trees were located which will be evaluated for resistance to the disease and the size of white pine chloroplast DNA has been estimated (Drs. Hunt, White and Meagher). Epidemiological studies were completed for cone rust basidiospore production and release (Dr. Sutherland). It was also discovered that the duration of Douglas-fir cone moth dormancy is not determined totally in the larval stages but may be affected during pharate adult development (Dr. Sahota).

Projections

Diagnosis and pest management recommendations will continue in seed orchards, nurseries and young plantations. The white pine blister rust research will emphasize finding resistant trees as the result of inoculation trials and the research will be intensified on biochemical and basic genetic aspects of the disease. Increased attention will be on grey mould biology and control in nurseries. Foliage diseases in seed orchards and young plantations will continue to be studied. Studies will be

completed on evaluating cone slicing for providing an operational index of seed counts. Experiments will begin for producing a monoclonal antibody against the moulting hormone of *Barbara colfaxiana* to assist in finding the reasons for dormancy in this insect.

Assessing the competing vegetation prior to conifer release treatment.

Forest weed control strategies

Project Leader: G.W. Coombs, R.P.F.

Professional: Dr. C.E. Dorworth, Dr. Y.J. Lee, Dr. J.F. Manville, Dr. E.T. Oswald, J.P. Senyk, R.J. Whitehead

Technicians: B.N. Brown, D. Craigdallie, T.L. Fraser, R.K. King, E.J. Stoffelsen

Objectives

To develop an understanding of site characteristics and ecosystem component interrelationships that influence vegetation succession patterns and site productivity following natural and man-made disturbances. To identify, develop and transfer to forest managers, forest weed control methods which achieve an optimum balance between silvicultural efficacy and impact on other resource values. To evaluate chemical/morphological responses of crop tree and weed species to various treatments. To develop management strategies aimed at preventing or reducing establishment of undesirable vegetation and loss of site productivity. To develop the appropriate tools and techniques for N.S.R. recapture on selected site types in B.C.

Achievements

Cooperative field assessments by Forest Pest Management Institute and P.F.C. personnel were conducted of the results of the 1984 aerial Roundup application in

the Carnation Creek study area. The compilation of this field data is currently underway. Final preparation of field layout in the joint Ministry of Forests/Canadian Forestry Service, Skeena River Garlon study was completed in early summer. However, due to a late summer court action by an Indian Band in the Terrace area, which halted any herbicide applications, the Skeena Study was cancelled indefinitely. Preliminary personal contacts and field reconnaissances were carried out in the Southern Interior to identify potential study sites for PC 34-03.

Four new Study Leaders and a new Project Leader were assigned to this Project. This resulted in three new studies being added and one existing study rewritten to expand its objectives.

Extensive contact of information exchange in the form of lectures, meetings and discussions were made with the B.C. Ministries of Forests, Ministry of Environment, Department of Fisheries & Oceans, industry, universities & other groups. P.F.C.'s activities within the Expert Committee on Weeds were expanded when J.F. Manville was elected chairman and R.J. Whitehead was appointed summarizer.

Projections

This project has redirected its emphasis to look at the total vegetation community and the effects of natural and man-made disturbances on vegetation control in each community.

Representative problem sites will be selected in the Southern Interior to lay out and conduct baseline vegetation assessment for evaluation of motor-manual and chemical methods of early conifer release.

A reconnaissance of the Southern Interior to identify potential study sites will be conducted. Forest vegetation, site productivity and advance regeneration will be examined within specific undisturbed ecosystems and will be related to NSR conditions after disturbance. The second post-treatment assessment, data analysis and report of the Carnation Creek Roundup conifer release trial will be completed. The usefulness of satellite photography and remote sensing in monitoring the effects of various forest weed control methods will be examined. Staff will isolate, identify and carry out primary field evaluations of pathogens which have potential to control various undesireable species of vegetation on the Coast and in the Interior.

Digital imaging for forestry

Project Leader: Dr. F.G. Peet

Objectives

To research, develop, and apply digital image processing techniques to problems in forestry in the areas of forest entomology, tree diseases, and tree reproduction.

Achievements

Prior to 1985/86 a digital imaging system for forest entomological studies had been developed and enhanced, and a prototype system for studying electrophoresis gels of forest related material was developed and applied. During the past year work proceeded on converting the systems to a new microcomputer.

Projections

During the coming year the conversion of the system will continue.

Systems studies in regional forest management problems

Project Leader: Dr. A.J. Thomson

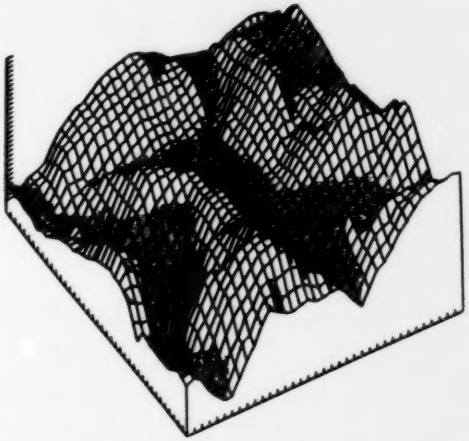
Professionals: Dr. H.J. Barclay

Objectives

To evaluate effects of selected pests and forest management practices on tree and stand growth, and to develop models and management systems.

Achievements

Models of periodic inundation of parasitoids for pest control were developed and evaluated. Effects of dwarf mistletoe on the growth of western hemlock were determined. The relationship of lodgepole pine phloem thickness to tree growth characteristics was determined for inclusion in mountain pine beetle hazard rating systems. Systems for analysis of digitized iso-electric focusing gels were developed and applied. The use of trend surface analysis for detecting microsite variability was demonstrated.



Digital terrain model showing shadows cast by the sun on hillsides. Rates of pest development and bud growth are influenced by the amount of direct sunlight a site receives.

Projections

Theoretical models of insect population dynamics will continue to be developed to shed light on particular processes, and especially on the consequences of parasitoid inundation. Data analyses will be carried out to define relationships for inclusion in forest management models, especially in the areas of white spruce site preparation, coastal Douglas-fir growth, and effects of lodgepole pine stocking standards on mountain pine beetle population dynamics.

Microtechnique and electron microscopy

Project Leader: Lesley E. Manning

Objectives

To maintain an optical and electron microtechnique facility capable of providing the required assistance to the various research studies at PFC. To develop and refine skills and methodology needed in specialized research including ultramicrotomy, sample preparation, and photographic interpretation.

Achievements

A wide variety of research studies benefited from the optical and electron microtechnique facility at PFC.

An ongoing study of white pine blister rust involved the scanning electron microscope (SEM) examination of *C. ribicola* spores on white pine needles to check germination progress prior to plastic embedding for light microscopy and TEM.

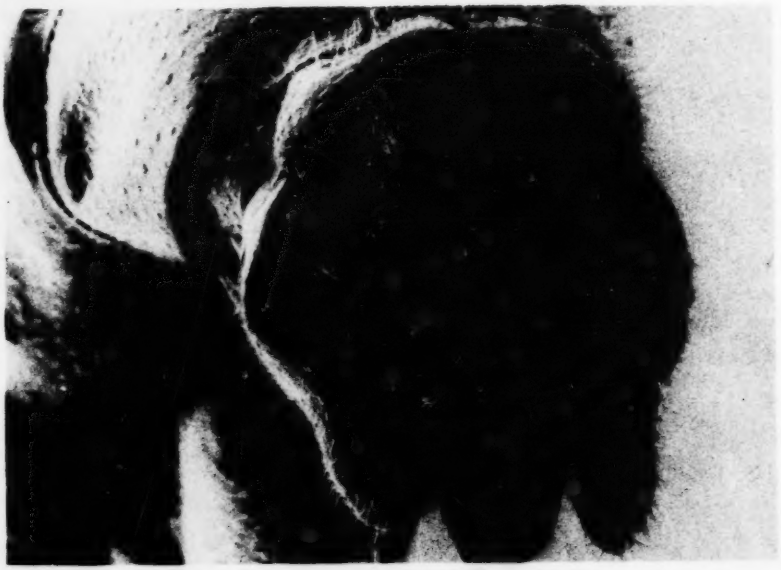
SEM pictures were taken to identify sense structures on antennae, ovipositors, etc. of adults and larvae of various parasitic flies, parasitic wasps, and moths.

Mushrooms and fungal colonies on agar, leaves and tree stems were prepared for SEM as were fungal spores, wood samples from defoliated trees, *Dendroctonus* spp. bark beetles and other bark beetles.

Herbicide treated alder samples were sectioned with the sliding microtome, wax embedded for rotary microtome sections and prepared for SEM examination. Light microscope slides were prepared of mountain pine beetle larvae suspected of containing virus particles, black army cut-worm larvae and pupae, larch bud moth and *Sirococcus* pycnidia.

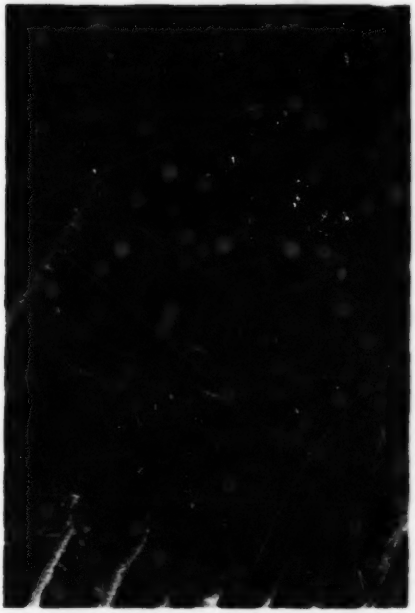
Projections

Research will continue to further develop and adapt techniques for transmission and scanning electron microscopy while maintaining the classical histological services to all research studies at PFC.

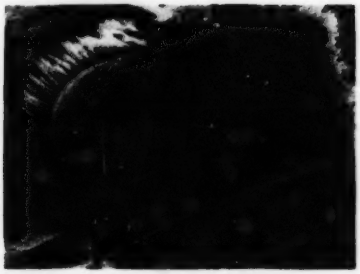


Spruce weevil parasite (X110).

Dolichomitus female (X20).



Douglas-fir tussock moth antenna (X3200).



Spruce budworm adult (X25).

Dolichomitus ovipositor tip (X80).

4

Fruit Relations and Development

J.A. Edwards, Program Director

Production of an instructional videotape on coastal root diseases.

Forestry relations and technology transfer

Project Leader: J.P.G. de Lestard

Professional: J.C. Edwards

Objectives

To provide liaison and consultative services in order to advise existing and potential clients, co-operators and others of the scope of research and development expertise and information available at the Pacific Forestry Centre. To aid scientists in developing practical applications for research discoveries and assist clients in a timely and effective manner to incorporate the results into management and operational systems. To assess forest resource development issues and initiatives and provide professional support during the development and implementation of forestry agreements.

Achievements

Forest industry, industrial association and native group representatives were visited throughout central and northern B.C. and Yukon during the summer of 1985 to provide information on PFC research, development and job creation initiatives and activities.

Prior to 1985, the CFS had obtained the co-operation of the Yukon Lands and Forest Service to participate in outplanting trials using improved Svenska Cellulose Ltd. seedlings from first generation lodgepole pine and other species. Balco Industries Ltd. agreed to grow the seedlings for planting in 1986. The CFS assisted with the final selection of outplanting sites in Yukon and in northern B.C.

Other forestry relations activities included: providing liaison services to the forest industry, provincial Ministry of Forests, universities and public; organizing and participating in tours for professional, domestic and international forestry visitors; serving on the Canadian Host Committee for the 12th Commonwealth Forestry Conference; representing the Canadian Forestry Service at meetings and symposia; speaking at public sessions on behalf of the Canadian Forestry Service; chairing the PFC Open House '86 Steering Committee; assessing and monitoring FRDA Direct Delivery proposals; preparing and revising ministerial briefings and information notes; developing a Master Agreement between Simon Fraser University and PFC; providing professional forestry advice and assistance to CFS Headquarters and PFC management and staff on research and development issues; serving as the HAMPCO Working Group Chairman for the 1986 CIF Annual Meeting in Victoria; locating technology transfer items which might be applied to forestry field operations and management systems; and managing the technology transfer services study to promote the expeditious transfer of technology to clients and co-operators.

Technology transfer activities included: providing technical advice and assistance during the production of a joint PFC/MacMillan Bloedel Ltd. instructional video tape on the control and management of Phellinus weirii root rot and a video tape describing the Canada – British Columbia Forest Resource Development Agreement; preparing an Open House '86 display explaining the role of the Forestry Development and Relations group; particpating in the Open House '86 organization; participating in the 12th Commonwealth Forestry Conference by assisting with Day Tours and by being a rapporteur for the official opening of the PFC extension; assisting with the evaluation of a handbook on documenting prescribed burn data; assisting scientists with the preparation of patent submissions; providing technical advice to industry regarding the use of diatomaceous earth as a forestry insecticide; exploring a new-concept device to do inverted mounding for site preparation; compiling a list of federal sources of funding for forestry-related research in Canada; providing technical liaison for an interagency Garlon herbicide research project at Terrace, B.C.; completing a report entitled *Herbicide Applications Technology in Forestry: An Analysis for British Columbia*; presenting a paper on technology transfer at the Western Forest Insect Work Conference in Victoria and participating in a BCMF workshop on forest fertilization.

Projections

Liaison activities will be expanded throughout the Pacific and Yukon Region to impart information relevant to ongoing research and development activities at the Pacific Forestry Centre. Regional research and development concerns will be assessed along with technology transfer opportunities. Activities will include transferring technology to increasing numbers of domestic and international visitors; developing Master Agreements with major universities to enhance research and

teaching and maximize the use of existing facilities by graduate students and participating on forestry advisory and other committees.

Technology transfer activities will include the provision of professional assistance to produce an instructional video tape on the dwarf mistletoe disease and with root rot and prescribed fire workshops. Logistics will be arranged for a national seminar on the Canadian Forest Fire Danger Rating System. Technology transfer opportunities will be identified and recommendations made regarding proposals submitted to the FRDA direct delivery Technical Advisory Committee on Extensive Demonstration and R&D. The report entitled *Herbicide Applications Technology in Forestry: An Analysis for British Columbia* will be published.

Development of economic guidelines

Project Leader: G.H. Manning

Professionals: G.A. Fraser, W.E. Nicholson, E.A.F. Wetton, W.A. White

Technicians: C. Macklin, J. Rudd

Objectives

To provide economics and policy advice to the department, its cooperators, and the management and staff of PFC, to improve the information base in forest economics, and manage PFC's participation in the ENFOR program.

Achievements

The major thrust of the project continued to be support of the new Canada-B.C. Forest Resource Development Agreement. Economic studies underway included a study of forest dependent communities (completed), investigation of the labor content of silvicultural programs, and techniques for assessing benefits and costs of forestry programs and a study of higher value added opportunities in the B.C. forest industries. Late in the year a set of studies related to valuation and optimization of intensive forest management opportunities was initiated.

During 1985/86 W.A. White was on educational leave at Simon Fraser University until September, and G.A. Fraser was secunded to CFS Headquarters for the same period. Dr. E.A.F. Wetton replaced Fraser on a term appointment. W.E. Nicholson joined PFC late in the year from Crown Zellerbach Research, Wilsonville, Oregon.

With regards to ENFOR, in 1985-86, two contracts were in progress: development of a model to evaluate ENFOR program and, development of a rock sorter for the biomass reporator-shear.

Projections

The project will continue to provide planning, economic and policy advice and liaisons as required by CFS/PFC staff and other client agencies. Specifically, studies related to evaluating the FRDA will be initiated, as will studies related to marketing and utilization opportunities for B.C. forest industries. Other research studies will continue, as will management of the ENFOR program.

Program implementation

Project Leader: V.G. Ulrich

Professionals: W. Stokes

Objectives

To represent CFS interest in the implementation, administration and evaluation of the development initiatives. To provide coordination and administration guidance for the subvention programs dealing in external research and university support which includes programs to strengthen the forest research capability within the universities.

Achievements

Much time and effort was expended in support of the development of a five-year Canada/British Columbia Forest Resource Development Agreement — a $300 million cost-shared program.

A three-year "Program of Research by Universities in Forestry" (PRUF) approved in early 1983/84, was completed. A decision is to be made to have a new three-year Program of Research in place by April 1, 1986.

A new 3 year CEIC Job Strategy was approved in early 1985/86. P.F.C. is to provide the technical expertise in assessing and monitoring forestry projects under the Job Development Program.

Projection

To provide advice and assistance on the implementation of a technology transfer and forestry relations program. To provide assistance and data as required to the planning progress and to CEIC on forestry-related programs.

ADDENDUM

Professionals
should read: W. Stokes, D. Mills, M. Atherton, J. Burch

4
Administration
R.M. Dean, Management Services Officer

Administration

Management Services Officer: R.M. Dean

Librarian: A. Solyma

Finance Officer: W.D. Evans

Physical Plant: E.K. Hopps

Photographer: E. Chatelle

Administrative Support: J. Andersen, D. Barwise, P. Chambers, L. Donk, A. Eng, S. Flarrow, B. Gee, H. Gray, D.A. Greenway, R. Hagel, H. Henriksen, J. Horsland, E. Hosie, R. Hughes, A. Inness, M. Johnson, G. Kazmiruk, H. Matson, R. McPhee, M. Mitchell, M.D. Mosely, L. Johnson, W.A. Pearce, S. Reid, R.M. Richardson, S. Schaub, J. Strobbe, B.J. Vander Heiden

Objectives

To provide a system of financial control and accountability in accordance with statutory and regulatory requirements. To provide general administrative support services including material management, financial services, records management, secretarial services, vehicle fleet management and reception-switchboard services. To provide physical facilities for the total Centre and eleven field locations.

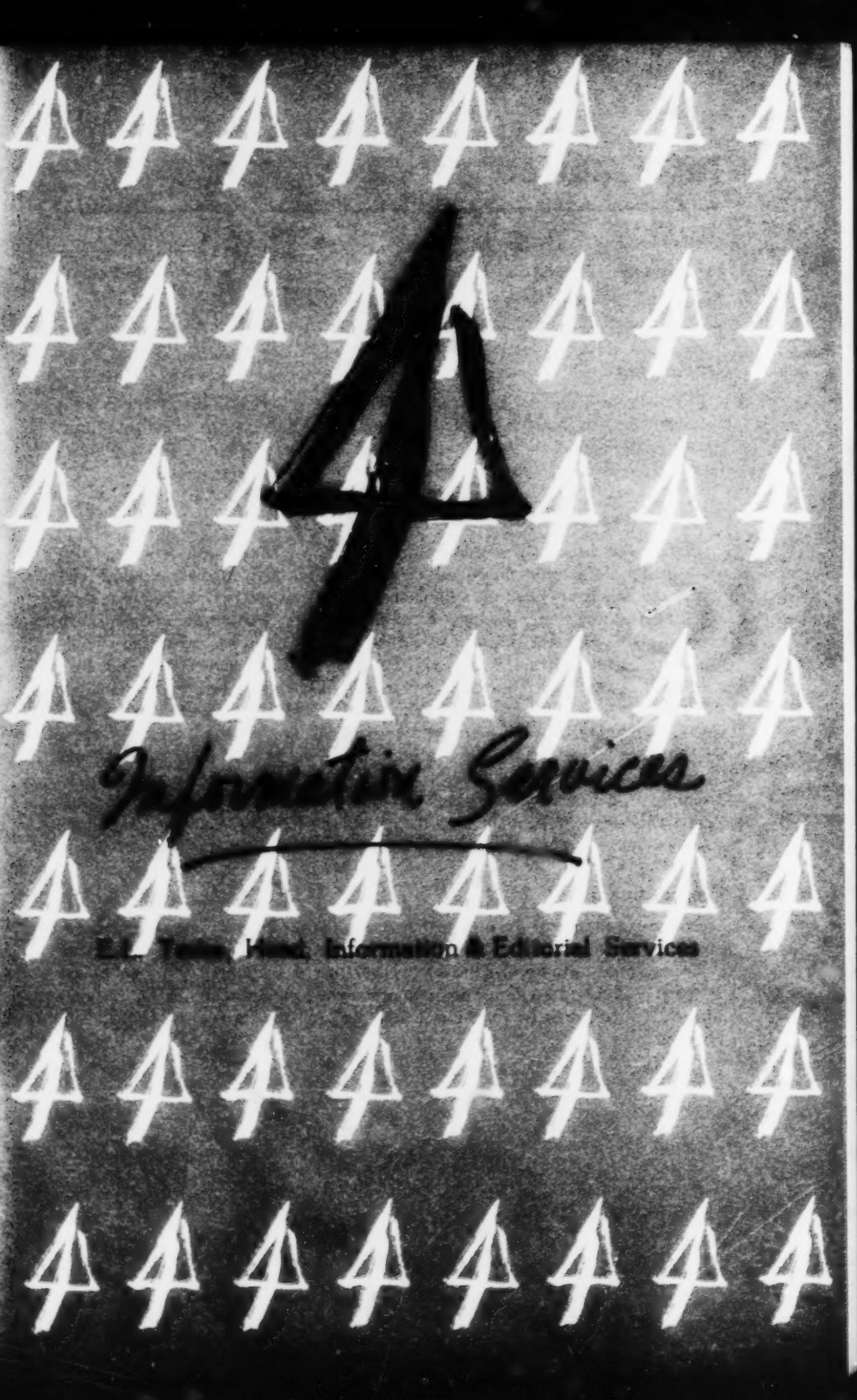
Achievements

Financial management and accountability was conducted in accordance with the objectives of the Centre and within the statutory and regulatory requirements. Basic services were provided to all staff despite major disruptions due to new construction and renovations to the original building. Equipment used by the word processing unit was upgraded with the purchase of new WANG work stations, as was the photography laboratory with the provision of new graphic arts equipment. Major renovations were completed to the shade houses and a new tractor was purchased for grounds maintenance. The vehicle fleet size was maintained at 50 units.

The Library occupied new quarters in January 1986 and is now fully operational.

Projections

Administrative and support services will continue to be provided to the research and development programs but the loss of two person years will impact on this service. A new sub-office will be opened in Prince George in late May or early June for the Forest Relations and Development Program and two seasonal residences will be replaced for the FIDS program. The fleet will be expanded by four units to provide transportation for the eighteen new Development positions. It is expected, that Public Works Canada will issue a final construction contract to address a number of modifications that are now required.


4
Information Services

Information services

Project Leader: E.L. Teske

Professional: D. Barkhouse, S. Glover

Support: B. Page, J. Wiens

Objectives

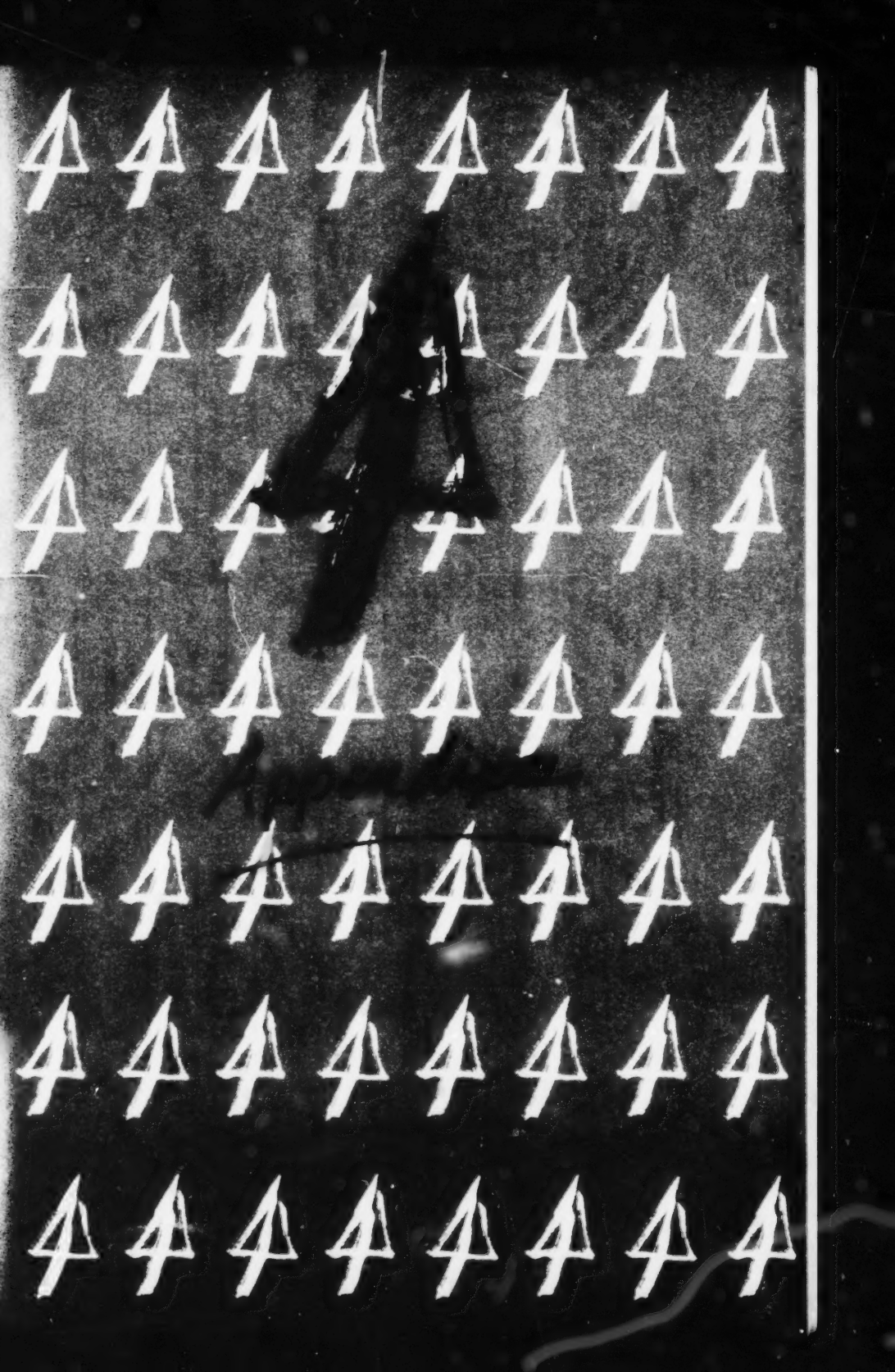
To provide the Centre with editorial and graphic services; to act as the channel through which creative contact is maintained with the public, the forest community, national, regional and local news media, editors and printers; to produce booklets, new releases, exhibits; and to handle telephone and written enquiries.

Achievements

Organized and directed a very successful Open House 86 to which close to 11,000 visitors toured the facilities and viewed projects on display. Media and public relations support was provided the 12th Commonwealth Forestry Conference, including the co-editing and publishing of the proceedings. A communications plan in support of the Forest Resource Development Agreement was developed in conjunction with the province. Two workshops on "constructive citizen participation" were held to train staff in the hows and whys of dealing with external clients. Staff coordinated the official opening of the new building by the Minister, the Honorable Gerald S. Merrithew. In support of the ongoing programs at the Pacific Forestry Centre staff provided editorial and graphic services; answered enquiries from clients; published issues of Information Forestry; issued news releases, backgrounders and speeches; maintained contact with media; organized 1985 National Forest Week activities for the CFS in the region; organized seminars and workshops and published 14 Information Reports and over 80 journal articles.

Projections

To continue to promote activities and programs of the CFS in the region by providing editorial, graphic and public relations services. To cooperate with the Canada Council of Forest Ministers in the regional conduct of a national forestry awareness campaign. To conduct a public opinion/awareness poll on forestry in B.C. To support the federal sub programs under FRDA by publishing brochures, leaflets, site signs, etc.



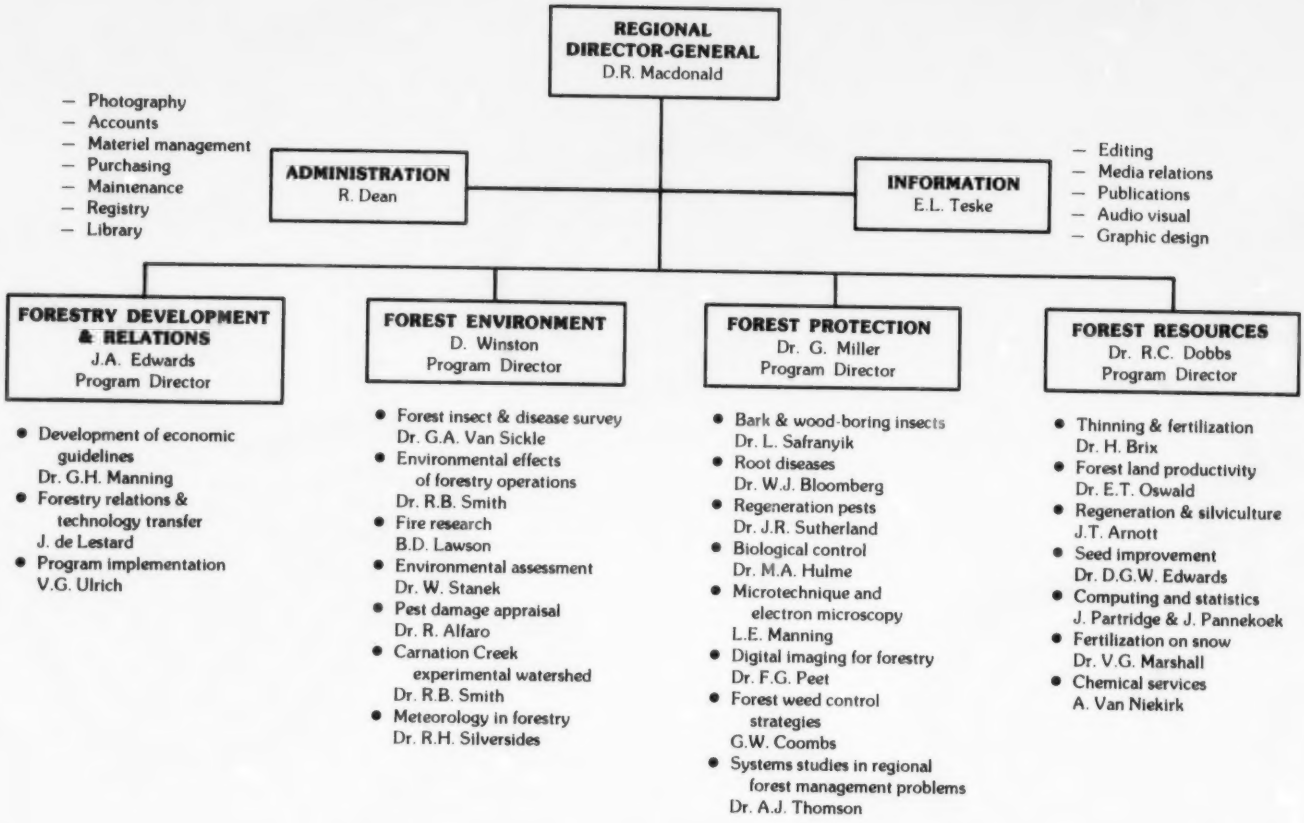
Pacific Forestry Centre

1985-86 Expenditures

($000's)

Program Area	Person Years	Salaries	O&M	Capital	Contributions	Total
Directorate (includes Information Services	10.5	$ 585.2	$ 319.4	$ 1.0	—	$ 905.6
Administration (includes Plant Operations)	36.3	893.1	872.6	386.1	—	2151.8
Resources	42.0	1806.7	427.8	903.3	—	3137.8
Protection	38.2	1694.9	221.4	101.9	—	2018.2
Environment	35.2	1419.9	221.6	98.3	—	1739.8
Development/Economics	18.4	764.7	238.8	62.9	$9403.3	10 469.7
Total	180.6	$7164.5	$2301.6	$1553.5	$9403.3	$20 422.9

PACIFIC FORESTRY CENTRE



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